COTTAGERS' SELF-HELP PROGRAM

ENRICHMENT STATUS OF LAKES

IN THE

SOUTHEASTERN REGION OF ONTARIO

1993

JUNE 1994

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Acknowledgments

The acquisition of data on of our lakes would not be possible without the assistance of hundreds of volunteers who undertake water quality sampling and other observations. The data that they help to provide contributes substantially to the effective management and protection of our recreational lake resource. We acknowledge with special appreciation the following 72 organizations and individuals who have been responsible for ensuring a ten or more year record of participation in the Self-Help Program.

Ashby Lake Protective Association
Bagot Long Lake Cottage Association
Baptiste Lake Association
Bass Lake Cottage Association
Battersea-Loughborough Association
Beaver Lake Protective Association
Big Rideau Lake Association
The Greater Bobs Lake Association
Bon Echo Provincial Park (Mazinaw, Joe Perry Lakes)
Brule Lake - Mr. G. F. Carleton
Buck Lake Protective Association
Burridge Lake Cottage Association
Calabogie Lake Estates, Ltd.
Charleston Lake Provincial Park
Charleston Lake Ratepayers Association
Chimo Park Community Association (Black Donald Lake)
Chippego Lake - Mr. D. Buchan
Christie Lake Association
Crosby Lake Cottage Association
Crowe Lake Property Owners Association
Dalhousie Lake Association, Inc.
Davern Lake - Mr. R.S. Christy
Desert Lake Property Owners Association
Diamond Lake Cottagers Association
West Devil Lake Property Owners Association
Eagle Lake - Mrs. Rita Biddle, Mr. R. Langlais
Farren Lake Association
Gananoque Lake Property Owners Association
Glanmire Lake Cottage Association
Mackie Lake - C.J. Tooley & R. J. Sherlocke
Mazinaw Lake Cottage Association
North Shore Grippen Lake Cottage Association
Gunter Lake
Hay Bay - Mr. R. F. Sanderson
Indian Lake Cottage Association

Kennebec Lake Cottage Association
Killenbeck Lake - Mr. W.E. Brooks
Lake St. Peter Rate Payers Association
Limerick Waterways Ratepayers Association
Little Silver Lake Property Owners Association
Lower Beverly Lake Protective Association
Mink Lake Betterment Association
Mississippi Lakes Betterment Association
Moira Lake Property Owners Association
Mosque Lake - Mr. J. O'Dette
Muskrat Lake - G. L. Mitchell
Norway Lake Property Owners Association
Olmstead Lake - Mr. B. Briscoe
Opinicon Property Owners Community
Otter Lake - Dr. A. W. Khan
Otter Lake Frayn Road Cottage Association
Otty Lake Association
Paugh Lake Cottage Association
Pike Lake Property Owners Association
Pinnacle Point Road Cottage Association (Kennebec Lake)
Red Horse Lake - Mr. J. T. Johnson, P.K. MacCormack
Robertson Lake Cottage Association
Sand Lake Estates, Inc. - R.K. Wanless
Saint Andrew Lake - Mr. R. H. Bain
Salmon Trout Lake Cottage Association
Shabomeka Cottagers Association
Sharbot Lake Property Owners Association
Sharbot Lake Provincial Park
Shawano Ratepayers Association (Dickey Lake)
Silver Lake Environmental Protection Association
Skootamatta District Ratepayers
Steenburg Lake Community Association
Stoco Lake Property Owners Association
Troy Lake - Mr. J. Arnold
Twin Sisters Lake Ratepayers Association
White Lake Water Quality Committee

Summary

This report is the 19th of a continuing series of reports on the Cottagers' Self-Help Program for the Southeastern Region of Ontario. The Self-Help Program relies on the voluntary assistance of cottagers and other waterfront property owners to monitor the water quality of our inland recreational lakes. The monitoring consists of making regular observations on water clarity and collecting samples of water for determination of their algae content. Although water clarity and algae are only two measures of water quality, together they provide a very good indication of the condition of a lake, especially in terms of its suitability for cottaging and associated recreational uses.

This report presents the monitoring results for 88 lakes enrolled in the Self-Help program in the southeastern region of Ontario during 1993. The southeastern region includes Hastings and Prince Edward Counties and extends eastward to the Ontario-Quebec border. In general, water quality of the lakes was very good. In contrast to the general situation, high levels of algae were observed in a few lakes. The levels may have occasionally been high enough to have detracted from their recreational use and enjoyment.

In addition to water quality data, the report provides information to help cottagers protect their lakes through such practices as maintaining their sewage systems in good order.

The Self-Help Program facilitates the collection of data that is extremely important for effective lake water quality management. Detailed baseline lake studies completed by the Ministry of Environment and Energy have been supplemented by water quality observations collected through the Self-Help Program. For a number of lakes, almost 25 years of data have been collected. Long term databases allow for an assessment of normal variability in lake water quality and provide an opportunity to determine if any trends are developing. Combined with other sources of information, the data collected through the Self-Help program provide a basis for a better scientific understanding of our lakes and their protection.

INTRODUCTION

Water Quality and Lakefront Development

As a result of our geological legacy we are fortunate to have many hundreds or even thousands, of lakes. They are one of our most valuable natural resources. Because of our rich lake heritage, outdoor summer recreation and water have become almost inseparably linked. A primary example of this linkage is the summer cottage. Increasing amounts of leisure time combined with easy accessibility of many lakes from urban centres have culminated in the development of their shorelines with summer cottages, permanent homes, campgrounds and vacation resorts.

Eutrophication

Shoreline development and the accompanying increases in recreational activities around lakes can threaten their water quality and alter the very feature that attracted people to them in the first place. One consequence of watershed or shoreline development is an increase in the rate of supply of plant nutrients, particularly phosphorus and nitrogen, to a lake. Phosphorus and nitrogen are fertilizers. They promote the production of aquatic weeds and algae. Algae are microscopic green plants. One type of algae, the phytoplankton, grow dispersed throughout the water of a lake. Other types of algae grow attached to rocks, underwater plants and other submerged surfaces. Increased production of plants and algae give rise to increased productivity at all levels of the food chain up to and including fish. The nutrient enrichment of waters and the attendant increases in biological productivity are scientifically referred to as **eutrophication.**

A certain amount of nutrient enrichment or eutrophication is beneficial. Aquatic plants and algae are absolutely essential to the proper functioning of a healthy and well-balanced lake ecosystem. They provide food and shelter for fish and other aquatic life and through the process of photo-synthesis replenish the vital supply of oxygen in the water. However, from a recreational use perspective, eutrophication can be undesirable.

Increasing levels of phytoplankton cause a lake to become progressively greener and more turbid. The increased turbidity produces a decline in water clarity while more nearshore weeds and algae interfere with swimming and boating. In cases of extreme nutrient enrichment, algal blooms occur. Algal blooms are often evident as pea-soup scums on the surface. Under these conditions a lake may become unsuitable for recreational activities, particularly those that involve body contact with the water such as swimming.

Algal blooms affect more than just the surface of the water. As the algae die, they sink and decompose. The decomposition uses up the limited supply of oxygen at the bottom of a lake. Deep water fish such as lake trout and other aquatic life that are found at the bottom of the lake are deprived of the oxygen they need to survive. In very shallow lakes, oxygen depletion seldom occurs because wind induced mixing and photosynthesis keep the water well oxygenated all the way to the bottom.

Sources of Nutrient Enrichment

Nutrients occur in a lake naturally. They originate in surface water runoff from the surrounding land, by atmospheric deposition directly on the lake surface and by resolubilization from lake bottom sediments. Nutrient levels, however, can be influenced by human activities. Disturbance of the terrain or ground cover around the lake that exposes soil to erosion increases the supply of nutrients bound to sediments in surface runoff. The use of manure and artificial fertilizers in agriculture and for residential lawns and gardens can also increase the supply of nitrogen and phosphorus in runoff. Increases in the volume and concentrations of nutrients in runoff often occur as a result of development.

Another potential source of nutrients that occurs as a result of shoreline development is domestic sewage waste systems. Human and household sewage contain phosphorus and nitrogen. The most common form of sewage disposal in rural areas where cottage

development occurs is a septic tank - leaching bed system. A leaching bed provides for an underground release of a liquid effluent. Although conventional septic tank - leaching bed systems are extremely effective at removing bacteria from sewage they are not always as effective in their ability to remove phosphorus and nitrogen. Nitrogen and phosphorus in a sewage effluent released from a leaching bed can travel through the soil or via groundwater to reach an adjacent lake or watercourse. Although a portion of the nutrients in the effluent are absorbed by soil and removed through uptake by vegetation, some of the phosphorus and nitrogen invariably reaches the lake.

Limitations for Shoreline Development

Some lakes are naturally productive of weeds and algae. Even the best land use planning and lake management practices will not eliminate water quality problems associated with eutrophication. In other lakes, the growth of weeds and algae can be limited by preventing phosphorus and nitrogen from reaching the lake. In the forested and sparsely populated PreCambrian regions that make up most of cottage country one of the more obvious controllable sources of nutrients are those associated with shoreline development. On certain, sensitive lakes, restrictions and controls on development may be necessary to protect their water quality.

LAKE SURVEYS AND WATER QUALITY MONITORING

Baseline Water Quality Surveys

In 1970 the Province initiated a comprehensive lake water quality survey program. Detailed baseline studies were carried out to inventory the physical, chemical and biological characteristics of our lakes with special emphasis on defining their sensitivity to nutrient enrichment. Over 300 lakes were surveyed in the southeastern region of the

province alone. The southeastern region includes Prince Edward and Hastings Counties and extends eastward to the Ontario -Quebec border (figure 1). It encompasses an area of 35,523 square kilometres and contains a population of 1.2 million.

Most of the surveyed lakes were found to have excellent water quality. Continuing surveillance is necessary to maintain a current record of the water quality of the lakes and to define and understand any changes or trends if they are developing.

Self-Help Lake Water Quality Monitoring Program

The Ministry of Environment and Energy has neither the staff nor the resources to continually monitor the water quality of even a fraction of the lakes in the Province. Therefore, a "self-help" program was established to enlist the assistance of lake associations, individual cottagers and other interested waterfront property owners for this purpose. Participants in the Self-Help Program volunteer a half hour or so of time while they are at their lake to make a measurement of water clarity and to collect a sample of water every week to two and arrange for its delivery to a Ministry of Environment and Energy laboratory. The Ministry of Environment and Energy analyzes the samples for their algae content, compiles the data and interprets the results.

METHODS

Sampling Equipment and Sample Delivery Arrangements

Participants involved in the Self-Help Program are provided with a Secchi disc and other necessary sampling equipment, a detailed set of sampling instructions, sample submission forms and return shipping material by the Ministry of Environment and Energy. Arrangements are made for the cost of shipping water samples to the laboratory to be charged to the Ministry. In this way there is no direct out-of-pocket expenses incurred by the participants.

Figure 1: Map of the Southeastern Region of Ontario showing the location of inland recreatioanl lakes relative to the PreCambrian Shield (solid line) and Counties (dashed lines).

Secchi Disc Visibility Depth Measurements

Participants are asked to make water clarity measurements at a single sampling location at a central or open-water area of their lakes well removed from any localized shoreline influence. Water clarity measurements are made with a Secchi disc. A Secchi disc is a circular plate 20 cm in diameter that is painted with black and white opposing quadrants (figure 2). The depth at which it disappears from view when lowered over the side of a boat into a lake is a standard and widely used measure of water clarity. It is obviously one half the distance light travels through the water to the disc and back to the observer's eye. The depth of effective light penetration into the lake can therefore be approximated as twice the Secchi disc visibility depth. The region from the surface of the lake to the lower depth of effective light penetration is referred to as the **euphotic** zone. There is just sufficient light at the bottom of the euphotic zone to sustain photosynthesis and allow aquatic plants and algae to grow.

Water Sample Collections

A sample of water for determination of the amount of algae in the lake is collected at the same location as the Secchi disc visibility depth measurement. The Secchi disc visibility reading is used to determine the lower limit of the **euphotic** for the purpose of collecting the sample. The water sample is collected by lowering a bottle with a restricted opening in a weighted container to twice the Secchi disc visibility depth and raising it at a uniform rate so that it is just full or almost full when it reaches the surface. In this manner, a vertical composite sample equally representative of all levels of the **euphotic** zone is obtained. The water sample is preserved immediately after collection with 0.5 ml (five drops) of a 1/2 per-cent magnesium carbonate suspension to prevent the degradation of chlorophyll pigment and returned, usually within a day or two, to the Ministry of Environment and Energy.

A Secchi disc visibility depth is obtained by averaging the depth at which a 20 cm (8") black and white circular plate lowered into the water just disappears from view and the depth where it just reappears as it is pulled up.

Most of the phytoplankton (algae) are found in the illuminated region between the surface and twice the Secchi disc visibility depth.

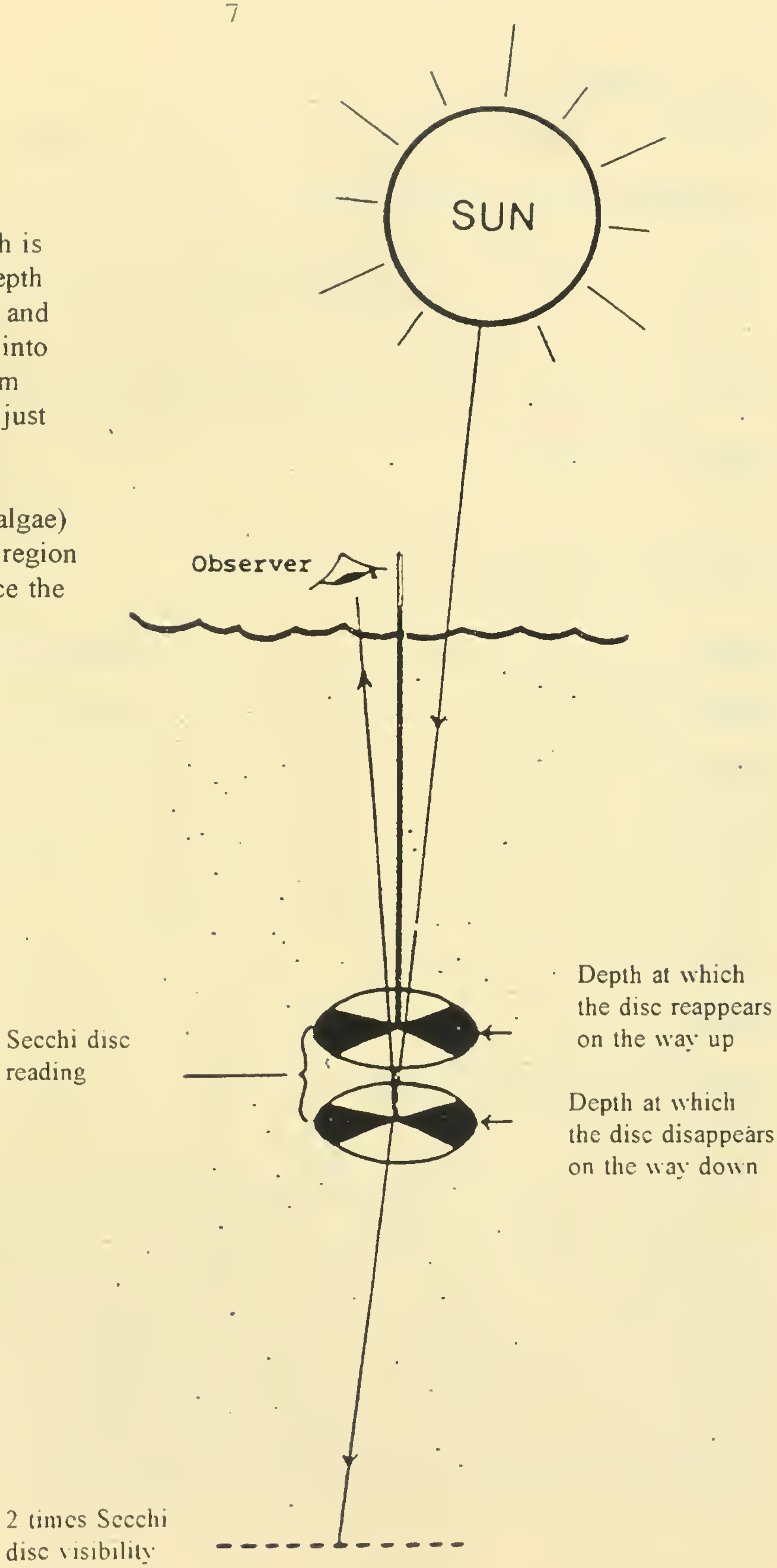

Figure 2: Diagram illustrating the use of a Secchi disc to measure water clarity.

Ancillary Observations

Each sample return is accompanied by a sample submission form which identifies the lake, location, and the date and time of the sample collection. The sample submission form is used to record the Secchi disc visibility depth measurement, the weather and other observations that might assist with the interpretation of the results or to account for any anomalies in algal populations or water clarity caused by wind drift or other environmental factors.

Chlorophyll Concentration Determinations

The water samples are filtered using a 1.2 micron millepore filter. The residue is extracted with acetone and the chlorophyll a concentration determined spectrophotometrically according to standard methods of the Ministry of Environment and Energy. Chlorophyll a is a green pigment found in all plants including algae. The concentration of chlorophyll in a sample of water is a chemical measure of the amount of algae present in the lake at the time of sampling.

RESULTS

Self-Help Program Participation

In 1993, 130 volunteers sampled a total of 106 separate locations on 88 different lakes in southeastern Ontario. A total of 1207 samples were received averaging just over 14 samples per lake. A number of lakes were represented by more than one sampling location. This is necessary for lakes that are divided into two distinct bodies of water such as Buck, Loughborough, or Moira and desirable for complex lakes that are comprised of a number of separate basins such as Baptiste, Big Rideau and Bobs which may act independently from a water quality point of view.

Of the 88 lakes enroled in the 1993 program, 80 were carried over from 1992, six were reintroductions after an absence during the previous year(s), while two, the north basin of Crotch and Fourteen Island were new to the program for the first time in 1993.

Individual Lake Reports and Tabular Summary of Results

Secchi disc visibility depth measurements and chlorophyll concentration determinations for all 106 sampling locations on the 88 lakes are summarized as seasonal mean values in Table 1. Results for individual sampling dates for each lake are provided as a series of separate lake data printouts which are being distributed along with this report. In addition to the current year's data, the individual lake data printouts contain a table of Secchi disc reading and chlorophyll concentration means for all the previous years this data has been collected and compiled. The record of previous mean values are intended to facilitate a comparison with the 1993 sampling results.

Lake Variability

Chlorophyll concentrations and water clarity may vary considerably at a given location from one sampling date to the next and over the growing season. It is not unusual for the maximum chlorophyll concentration to exceed two or three times the seasonal average. Unless a sampling program of sufficient frequency and duration to encompass any seasonal variability has been undertaken, a single statistic such as a sample mean may not be necessarily representative of a lake's condition. Ideally, 12 or more observations at regular intervals from the end of May to the beginning of October (for example, the Victoria Day weekend to the Thanksgiving weekend) should be collected. This is not always possible, depending upon a sampler's availability at the lake, and in many cases the data for a given lake represent conditions during the summer months only. Some discretion should be exercised in making comparisons between lakes and

Table 1: Mean chlorophyll concentrations (ug/L) and Secchi disc visibility depths (m) 1993

LAKE	COUNTY	CHLOR	SECCHI	NOTE
ALBION	HASTINGS	2.1	3.4	
ASHBY	LENNOX & ADD.	1.7	4.4	1
BAGOT LONG	RENFREW	5.0	2.9	
BAPTISTE	HASTINGS	1.4	4.1	
BASS	LEEDS	1.2	5.3	
BEAVER - NORTH BASIN	LENNOX & ADD.	4.3	1.7	1
BEAVER - SOUTH BASIN	LENNOX & ADD.	1.6	1.3	1
BIG CLEAR	FRONTENAC	1.3	4.7	
BIG GULL (CLARENDON)	FRONTENAC	2.4	4.0	
BIG RIDEAU	LANARK, LEEDS	1.8	4.3	
BIG RIDEAU - BRITON BAY	LANARK, LEEDS	1.4	4.4	1
BLACK	LANARK	1.9	5.1	
BLACK DONALD	RENFREW	1.1	5.9	
BOBS - BUCK BAY	FRONTENAC	3.1	3.8	1
BOBS - CROW BAY	FRONTENAC	3.5	4.5	
BOBS - EAST BASIN	FRONTENAC	2.3	4.4	
BOBS - GREEN BAY	FRONTENAC	1.5	4.3	
BOBS - MUD BAY	FRONTENAC	3.8	2.8	
BOBS - WEST BASIN	FRONTENAC	1.9	3.4	
BOULTER	HASTINGS	1.3	3.8	1
BRULE (WENSLEY)	FRONTENAC	1.1	7.9	
BUCK - NORTH BAY	FRONTENAC	2.7	4.2	
BUCK - SOUTH BAY	FRONTENAC	2.1	5.9	
BURRIDGE	FRONTENAC	1.0	5.1	
CANONTO	FRONTENAC	1.5	8.5	1
CASHEL	HASTINGS	1.0	5.3	
CHARLESTON - BIG WATER	LEEDS	3.0	3.8	
CHARLESTON - GOOSE ISLAND	LEEDS	2.9	3.8	
CHARLESTON - WESTERN WATER	LEEDS	2.5	3.8	
CHRISTIE	LANARK	1.9	4.4	
COLE	FRONTENAC	3.6	3.5	1
COLLINS - NORTH BASIN	FRONTENAC	3.5	3.1	1
CROSBY (BIG CROSBY)	LEEDS	3.2	4.5	
CROTCH - NORTH BASIN	FRONTENAC		5.5	1
CROTCH - SOUTH BASIN	FRONTENAC		6.3	1
CROW	FRONTENAC	2.5	5.3	1
CROWE	HASTINGS	1.9	2.8	
DALHOUSIE	LANARK	1.3	4.4	1
DAVERN	LANARK	2.2	4.2	
DEMPSEY (VIRGIN)	RENFREW	1.2	6.1	
DESERT	FRONTENAC	1.8	5.6	
DEVIL	FRONTENAC	2.1	5.2	
DIAMOND	HASTINGS	1.2	4.7	
DICKEY - NORTH BASIN	HASTINGS	1.1	4.7	
DICKEY - SOUTH BASIN	HASTINGS	1.1	5.3	
EAGLE	FRONTENAC	2.4	5.4	
ELBOW	FRONTENAC	2.9	3.1	
FARREN (FARRELL)	LANARK	1.4	5.5	
FOURTEEN ISLAND	FRONTENAC	1.8	4.6	
GANANOQUE	LEEDS	4.2	2.5	
GRIPPEN	LEEDS	2.0	3.0	1

LAKE	COUNTY	CHLOR	SECCHI	NOTE
GUNTER	HASTINGS	3.0	3.8	1
HAMBLY (SILVER)	FRONTENAC	1.9	4.4	1
HAY	NIPISSING	3.7	2.2	
HUNGRY	FRONTENAC	1.7		1
INDIAN	LEEDS	2.5	3.6	
JEFFREY	HASTINGS	1.0	4.2	
JEFFREYS (OLMSTEAD)	RENFREW	1.0	6.3	
JOEPERRY	LENNOX & ADD.	2.4	3.1	1
KASHWAKAMAK	FRONTENAC	3.0	3.1	1
KILLENBECK	LEEDS	3.0	2.9	
LIMERICK	HASTINGS	1.7	4.6	
LITTLE SILVER	LANARK	1.8	4.9	
LONG	FRONTENAC	5.2	2.8	
LOUGHBOROUGH - EAST BASIN	FRONTENAC	5.2	2.5	
LOUGHBOROUGH - WEST BASIN	FRONTENAC	3.4	5.1	
LOWER BEVERLY - OAK BAY	LEEDS	4.2	1.8	
LOWER HAY	NIPISSING	2.3	3.1	
MAZINAW	LENNOX & ADD.	1.0	4.3	
MCKENZIE	NIPISSING	1.5	4.6	1
MINK	RENFREW	2.0	4.3	
MOIRA - EAST BASIN	HASTINGS	3.1	2.8	
MOIRA - WEST BASIN	HASTINGS	6.2	1.7	
MOSQUE - NORTH & SOUTH	FRONTENAC	1.0	5.3	
MOSQUE - WEST BASIN	FRONTENAC	2.1	4.0	
MUSKRAT	RENFREW	5.2	3.2	
OPINICON	LEEDS	2.6	2.9	
OTTER	LEEDS	1.8	3.9	
OTTER - NORTH BASIN	FRONTENAC	2.7	4.5	1
OTTY	LEEDS	1.5	3.9	
PALMERSTON	FRONTENAC	1.1	9.4	1
PAUGH	RENFREW	1.0	5.1	
PIKE	LANARK, LEEDS	6.0	2.9	
RED HORSE - EAST BASIN	LEEDS	2.2	3.6	
RED HORSE - WEST BASIN	LEEDS	2.9	5.1	
ROBERTSON	LANARK	0.8	7.3	
SAINT ANDREW	FRONTENAC	3.9	3.2	
SAINT PETER	HASTINGS	1.4	3.8	
SALMON TROUT	HASTINGS	2.4	3.8	
SAND	LEEDS	2.4	3.6	
SHABOMEKA	FRONTENAC	2.2	5.3	
SHARBOT - EAST BASIN	FRONTENAC	2.7	4.1	
SHARBOT - WEST BASIN	FRONTENAC	2.1	4.5	
SHAWENEGOG	FRONTENAC	3.1	5.6	
SILVER	FRONTENAC, LANARK	1.5	3.5	
SKOOTAMATTA - WEST BASIN	LENNOX & ADD.		3.5	1
STEENBURG	HASTINGS	1.8	4.0	
STOCO	HASTINGS	6.0	2.0	
STONES	RENFREW	2.0	3.2	
TROY	HASTINGS	16.9	1.4	
TWIN SISTER - EAST BASIN	HASTINGS	3.2	3.7	
TWIN SISTER - WEST BASIN	HASTINGS	2.1	4.3	
UPPER RIDEAU	LEEDS	4.2	2.9	
WEST	PRINCE EDWARD	7.8	1.0	
WHITE	LANARK, RENFREW	6.1	2.8	
WOLFE	FRONTENAC	2.0	5.6	

1: The means may not necessarily represent the water quality of these lakes as they are based on less than 6 measurements.

from one year to the next. Averages that were derived from less than six sets of observations are noted in the summary table and should be excluded from any type of comparative data analysis.

Secchi Disc Visibility Depths

In the absence of highly coloured water or inorganic turbidity, Secchi disc visibility depends primarily on the amount of algae or phytoplankton in the water. Lakes with extremely low levels of algae are exceptionally clear and have high Secchi disc visibility depths. Lakes with high levels of algae are usually green or turbid by comparison and typically have low Secchi disc readings.

For example, in the clear and algae free waters of Brule and Robertson Lakes, the Secchi disc visibility routinely exceeded 7 metres. On the other hand, during periods of extremely high algal productivity in Troy Lake, the visibility fell below 1.0 metres. The overall average water clarity as measured by Secchi disc visibility depth for all 106 sampling locations was 4.1 metres.

Secchi disc visibility depth is only an approximate measure of biological productivity. It is influenced by other factors. These include the amount of sunlight when the reading is taken and the visual acuity of the person taking the reading. Secchi disc measurements are made principally to determine the depth of the **euphotic** zone for the purpose of collecting water samples for chlorophyll analyses. Chlorophyll is a more direct and practical measurement of algae and hence **eutrophication** than water clarity. When chlorophyll concentrations are combined with Secchi disc visibility depth measurements a good assessment of a lake's **trophic** condition can be made.

Chlorophyll Concentrations

In general chlorophyll concentrations were low during 1993. The average concentration ranged from 0.8 ug/L (micrograms per litre) for Robertson Lake to 16.9 ug/L for Troy Lake. The overall average concentration for all 106 sampling locations was 2.6 ug/L.

Effect of Weather on Yearly Results

Temperatures this summer were seemingly tropical compared to the summer of 1992, the coldest and wettest summer ever for the Kingston area. Temperatures during 1993 were a full degree Celsius above normal for both July and August and 0.6 degrees higher than normal for the month of June. It was a dry summer as well, with only 178 millimetres of rain, most of it (127.2 mm) occurring in June and well under the record 251.5 millimetres of rain that fell in 1992.

The drier weather apparently decreased the supply of plant nutrients available to many lakes during the growing season. Chlorophyll concentrations declined from 1992 to 1993 in many more lakes than those where it increased.

For the most part, increases in chlorophyll concentrations were relatively minor and probably not statistically significant. The most notable exceptions were Troy, Pike, Muskrat and White Lakes where chlorophyll concentrations more than doubled from 1992 to 1993. The reason for the magnitude of these increases is not clear, but is likely a result of resolubilization of phosphorus and other nutrients from bottom sediments. Lakes with an internal supply of nutrients are less effected by changes in rainfall and runoff patterns than lakes that are entirely dependent upon external sources for their nutrient supply.

Classification of Lakes

Lakes are classified on a continuously rising **trophic** (nutrient enrichment) scale according to their biological productivity. Traditionally, **trophic** state classification involves narrative descriptions of various factors and manifestations of enrichment such as nutrient concentrations, water transparency, profiles of dissolved oxygen with depth, the frequency and intensity of algal "blooms", plant and animal communities and even the physical dimensions of the lake itself. At the nutrient poor end of the scale are oligotrophic (unenriched) lakes and at the high end, eutrophic (enriched) lakes.
Oligotrophic lakes are characterized by low levels of chlorophyll and exceptionally clear water. They are usually deep lakes (more than 30 m). The shoreline is sparsely populated with aquatic plants. A stable fish population, often lake trout, provides a fair angling catch. The lake is well suited for a wide variety of recreational pursuits.
In contrast, **eutrophic** (enriched) lakes are more productive with higher concentrations of phosphorus and chlorophyll and poorer water clarity. Typically these lakes are shallow (less than 10 m) and often weedy and muddy. Fish populations do not include lake trout but may contain other sports species such as pickerel and bass. Angling success is generally better than for oligotrophic lakes since a more productive lake can sustain a larger population of fish. There is a good probability of one or more algal blooms developing in late summer or early fall. Under conditions of advanced eutrophy, eutrophic lakes may experience blooms throughout the growing season.

Mesotrophic (moderately enriched) lakes occupy an intermediate position in the classification scheme. They are intermediate with respect to depth, chlorophyll concentration, water clarity, and weeds. They may contain both warm and cold water fish populations.

While changes from trophic state do not occur at sharply defined stages, numeric criteria are useful in giving dimension to this classification scheme. Mean values for Secchi disc

visibility depths and chlorophyll concentrations can be used to compare the lakes with more than 6 sets of observations from table 1 and to rank them according to their nutrient enrichment or trophic status.

Table 2: Ministry of Environment and Energy Secchi disc - Chlorophyll Lake Enrichment Classification Scheme

Enrichment Status	Secchi Disc (m)	Chlorophyll (ug/L)	Number of Lakes	Per Cent of Lakes
oligotrophic	>5	<3	21	25%
mesotrophic	3 - 5	3 - 6	58	70%
eutrophic	<3	>6	4	5%

Lakes with less than 6 sets of observations are excluded from this table.

The simple allocation of a lake to a trophic state category based on solely one parameter may be of limited value. A lake that is classified as oligotrophic by its Secchi disc visibility may show signs of eutrophy based on other characteristics. For the purpose of the above table, a body of water was classified as oligotrophic only if both the mean Secchi disc depth was greater than 5 metres and the mean chlorophyll concentration less than 3 ug/l. Similarly it was classified as eutrophic only if the mean Secchi disc depth was less than 3 metres and the mean chlorophyll concentration was greater than 6 ug/L. All other lakes were classified as mesotrophic. In this way, the results of the 1993 Self Help water quality monitoring program indicate that 21 water bodies are oligotrophic, 58 are mesotrophic while only 4, the west basin of Moira, White, West and Troy are eutrophic. Fewer lakes were classified as eutrophic this year than last, and more were classified as oligotrophic. As indicated above, the oligotrophication of our waters is thought to be due to reduced nutrient loading in rainfall and runoff as a result of a dry

summer. Stoco, Muskrat and Upper Rideau Lakes which have been classified as eutrophic in previous years fell into the mesotrophic category in 1992 and did so again this year.

Classification as eutrophic does not necessarily imply use impairment. Use impairment is more closely related to the frequency and intensity of algal bloom occurrences than by seasonal average chlorophyll concentrations or Secchi disc visibility depths. Many oligotrophic lakes are gems of pristine beauty that offer little recreational opportunity beyond swimming and boating. Some eutrophic lakes are extremely valuable because of their ability to provide excellent fishing.

LAKE PROTECTION

The Province has the responsibility to ensure the proper management of the resources that we jointly share in Ontario including our provincial waterways. The Ministry of Environment and Energy sets limits on the quantities and concentrations of wastes that can be discharged to lakes and rivers. It also regulates the design and installation of private waste disposal systems such as septic tank - leaching beds. In many parts of the province, the field inspections and final approval of sewage systems are handled by a local Health Unit.

The Ministry of Environment and Energy also plays a proactive role in the protection of our waters through the process of land use plan review. Data provided through water quality surveys and the Self-Help Program have been instrumental in establishing guidelines for the capacity of lakes to accommodate shoreline development. This information is used by local and regional planning agencies in establishing land use policies for Official Plans and drafting zoning by-laws that regulate future lakefront development. The Ministry of Environment and Energy and the Ministry Natural Resources have jointly issued a report entitled **Inland Lake Trout Management in**

Southeastern Ontario. The report recommends land use and development controls on 53 lakes to ensure the protection of water quality for the maintenance of a sustainable lake trout fishery.

Existing waterfront property owners can also take individual responsibility in protecting their lake and its environment. The following is a list of practices that can be adopted to prevent or mitigate adverse impacts of residential use of shoreland. Most of these actions are intended to minimize additional nutrient inputs to the lake.

1. New cottage construction and septic tank systems should be set well back from the lake. This practice allows phosphorus in runoff and in leachate from tile fields to be absorbed by soil and taken up by vegetation rather than reaching the lake. Set-backs have the additional advantage of preserving the natural scenic beauty of the shore by preventing development from intruding unnaturally upon the lake.

2. Building site preparation and construction activities should be carried out in a manner that minimizes disruption to the soil and vegetation on the property. All areas that are exposed during construction should be replanted as soon as possible to prevent runoff and erosion.

3. Sewage disposal systems should be constructed and installed in compliance with Provincial Regulations and properly maintained. Septic tanks should be pumped out periodically to remove solids. If they are not pumped out the solids can clog the leaching bed and cause the system to back up. The area over the leaching bed should be left open to the sun and wind to encourage evapotranspiration. Protect the leaching bed from compaction by vehicles and traffic including snowmobiles. If foul odours are noticed or signs of excessive moisture and surfacing of water on the leaching field, contact the local Ministry of Environment and Energy or Health Unit office for advice.

4. Practice water conservation to avoid overloading your sewage disposal system. Automatic dishwashers and washing machines use large volumes of water which can place a strain on leaching beds. Take laundry back to the city for washing and do dishes by hand in the sink. Automatic dishwasher detergents have a high phosphate content and their use at a cottage should be avoided.

5. The shallow, near-shore, "**littoral**" zone supports most of the plant and animal life in a lake. Disruption of any part of this ecosystem threatens the entire cycle of life in the lake. In particular, habitat for fish and wildlife may be destroyed. A regulation under the Public Lands Act requires a permit from the Ministry of Natural Resources (MNR) for any shoreline work. This includes cutting weeds, stabilizing banks, removing rocks or stumps from the water, building a dock or dredging. The permit is free and application forms are available from district offices of the MNR.

6. Maintain a zone of natural vegetation (trees and shrubs) as a protective buffer between lawns and the lake or leave your entire lot in a natural state. If you must have a lawn do not over fertilize it as the runoff could contaminate your lakefront.

7. If the shoreline of your lake has been cleared of vegetation, have your cottage association join MAPLE (Mutual Associations for the Protection of the Lake Environment), a non-profit organization that assists landowners with the restoration of their shorelines. For more information or a brochure on the program please contact MAPLE at:

    P.O. Box 271
    PERTH, Ontario
    K7H 3E4

8. Help to ensure the continued enrollment of your lake in the Self-Help Water Quality Monitoring Program. On many lakes, cottagers' associations have been instrumental in coordinating self-help efforts and ensuring continuity of participation in the program. In addition to collecting scientific data on your lake, participation in the program helps to build an understanding of lake ecology and an appreciation of the importance of lake protective measures.

By adopting the above practices everyone can play a role in helping to protect and preserve the future of their lake.